UNITED STATES PATENT AND TRADEMARK OFFICE

UNITED STATES DEPARTMENT OF COMMERCE
United States Patent and Trademark Office
Address: COMMISSIONER FOR PATENTS
P.O. Box 1450
Alexandria, Virginia 22313-1450
www.uspto.gov

APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
10/657,140	09/09/2003	Hong-Mi Park	SEC.1042	1912

7590 04/21/2004

VOLENTINE FRANCOS, P.L.L.C.
Suite 150
12200 Sunrise Valley Drive
Reston, VA 20191

EXAMINER	
YEVSIKOV, VICTOR V	
ART UNIT	PAPER NUMBER
2825	

DATE MAILED: 04/21/2004

Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary	Application No.	Applicant(s)	
	10/657,140	PARK ET AL.	
	Examiner	Art Unit	
	Victor V Yevsikov	2825	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☒ Responsive to communication(s) filed on *09 September 2003*.

2a)☐ This action is **FINAL**. 2b)☒ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) *1-14* is/are pending in the application.

4a) Of the above claim(s) _____ is/are withdrawn from consideration.

5)☐ Claim(s) _____ is/are allowed.

6)☒ Claim(s) *1-14* is/are rejected.

7)☐ Claim(s) _____ is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

9)☐ The specification is objected to by the Examiner.

10)☒ The drawing(s) filed on *09 September 2003* is/are: a)☒ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

11)☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

12)☒ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☒ All b)☐ Some * c)☐ None of:

1.☒ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____.

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

1) ☒ Notice of References Cited (PTO-892)
2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
3) ☒ Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08) Paper No(s)/Mail Date *9/9/03*.
4) ☐ Interview Summary (PTO-413) Paper No(s)/Mail Date. _____ .
5) ☐ Notice of Informal Patent Application (PTO-152)
6) ☐ Other: _____.

DETAILED ACTION

Claim Rejections - 35 USC § 102

The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

> A person shall be entitled to a patent unless –
>
> (b) the invention was patented or described in a printed publication in this or a foreign country or in public use or on sale in this country, more than one year prior to the date of application for patent in the United States.

Claims 1, 4-7, 9 and 14 are rejected under 35 U.S.C. 102(b) as being anticipated by Kim et al. (US 5,985,759).

With respect to claims 1, 4-7, 9 and 14 Kim teaches a method of forming a contact in a semiconductor device, comprising:

forming an insulating layer 14 on a semiconductor substrate 12;

forming a contact hole 18 in the insulating layer by selectively etching a potion of the insulating layer;

forming a barrier metal layer 16 and 20 having a uniform thickness on the insulating layer and a surface of the contact hole;

forming a wetting layer 26 of an oxidation-resistive metal material on the barrier metal layer, and

forming a metal layer 28 on the wetting layer so as to fill the contact hole, and wherein:

4. the wetting layer is formed at a temperature of about 18^{o}C to

about 600°C (table 1);

5. the wetting layer is formed to a thickness of about 0-500Å;

6. the wetting layer is formed to such a thickness that sufficient space remains in the contact hole for the metal layer;

7. the barrier metal layer includes a titanium layer, a titanium nitride layer or a composite layer thereof;

9. the barrier metal layer is formed to such a thickness that sufficient space remains in the contact hole for the wetting layer and the metal layer;

14. the metal layer includes aluminum or an aluminum alloy.

Reference: figs. 1-7 with corresponding text.

Claim Rejections - 35 USC § 103

The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

Claims 2 and 3 are rejected under 35 U.S.C. 103(a) as being unpatentable over Kim in view of Smith et al. (US 6,344,281 B1).

Kim teaches the features detailed previously but lacks a discussion of the method wherein the wetting layer of an oxidation-resistive metal material includes

tungsten and wherein the wetting layer is formed by a chemical vapor deposition (CVD) process.

However, Smith teaches the method wherein the wetting layer of the oxidation-resistive metal material includes tungsten and wherein the wetting layer is formed by a chemical vapor deposition (CVD) process (col. 3, lines 33-38).

Therefore, it would have been obvious to one of ordinary skill in the art to use tungsten for wetting layer and CVD for depositing it as taught by Kim/Smith as a means to reduce thickness.

Claim 8 is rejected under 35 U.S.C. 103(a) as being unpatentable over Kim ('759).

Kim ('759) teaches the features detailed previously but lacks a discussion of using the PVD method for depositing titanium or titanium nitride barrier layer.

However, the used PVD to form barrier layers is notoriously well known to one of ordinary skill in the art. To support this assertion examiner cites col. 1, lines 34-46 of Kim ('759).

Therefore, it would have been obvious to one of ordinary skill in the art to use PVD method for depositing titanium or titanium nitride barrier layer as taught by Kim ('759) for reduce stress and providing high bottom coverage.

Claims 10-13 are rejected under 35 U.S.C. 103(a) as being unpatentable over Kim ('759) in view of Kim et al. (US 2002/0098682 A1).

Kim ("759) teaches the features detailed previously but lacks a discussion of the method:

wherein the metal layer is formed by depositing a metal material to such a thickness that the contact hole is partially filled, and re-flowing the deposited metal material to completely fill the contact hole and the metal material is deposited through a chemical vapor deposition (CVD) process or a physical vapor deposition (PVD) process; and

wherein the metal layer is formed by depositing a first metal material on the wetting layer by a chemical vapor deposition (CVD) process to such a thickness that the contact hole is partially filled with the first metal material; depositing a second metal material on the first metal material by a physical vapor deposition (PVD) process, and re-flowing the first metal material and the second metal material to completely fill the contact hole and wherein the first metal material is the same as the second metal material.

However, Kim('682) teaches the method:

wherein the metal layer is formed by depositing a metal material to such a thickness that the contact hole is partially filled, and re-flowing the deposited metal material to completely fill the contact hole and the metal material is deposited through a chemical vapor deposition (CVD) process or a physical vapor deposition (PVD) process; and

wherein the metal layer is formed by depositing a first metal material on the wetting layer by a chemical vapor deposition (CVD) process to such a thickness that the contact hole is partially filled with the first metal material; depositing a second metal material on the first metal material by a physical vapor deposition (PVD) process, and

re-flowing the first metal material and the second metal material to completely fill the contact hole and wherein the first metal material is the same as the second metal material.

Reference: §0038, claim 1.

Therefore, it would have been obvious to one of ordinary skill in the art to use PVD and CVD for depositing metal materials on the wetting layer as taught by Kim '759)/Kim (682) with results in controlling abnormal growth of the CVD metal.

Conclusion

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Victor Yevsikov whose telephone number is (571) 272-1910. The examiner can normally be reached on Monday –Thursdays 8:00-5:30.

If attempts to reach the examiner by telephone are unsuccessful, examiner's supervisor, Matthew S. Smith, can be reached on (571) 272-1907. The fax phone numbers for the organization where this application or processing is assigned is (703) 873-9306.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published application may be obtained from either Private PAIR or Public PAIR. Status information for unpublished application is available through Private PAIR only. For more information about the PAIR system, see http://pair-direct.uspto.gov. Should you have questions on

access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free).

V. Yevsikov

Victor Yevsikov
Examiner
Art Unit 2825

April 7, 2004

MATTHEW SMITH
SUPERVISORY PATENT EXAMINER
TECHNOLOGY CENTER 2800